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Science and Art Gossip.

THE comet which came to perihelion on Sept. 17 last seems to be a return of the comet of 1668, which is probably the same as the comet of 1843 and the comet of 1880. If so, there seems every reason to believe that a few months will see the comet back yet again, and that the end then will not be far off,—the end of the comet, we mean, not that of the earth, as some seem to imagine.

THE orbit of the comet of 1843 is shown elsewhere. Dr. Hind's elements of the new comet differ considerably from this orbit, but they do not agree well with the observations. He infers that the elements were much affected during perihelion passage on Sept. 17. His elements are as follows:—

Perihelion passage, Sept. 17·1047, M.T. at Greenwich. (This means about half-past two in the afternoon of Sept. 17):—

	°	′
Longitude of Perihelion	271	39·5
„ „ Ascending node	347	44·6
Inclination	37	9·6
Logarithm of Perihelion Distance	8·09201	

Motion—retrograde.

THE comet was first seen by Mr. Finlay, First Assistant at the Government Observatory, Cape of Good Hope, at 5 a.m., on Sept. 8. He gives its place thus at 5 h. 14 m. a.m. on the 9th:—

Cape M. T.	R. A. °	′	″	Dec. °	′	″
Sept. 8, at 17 h. 13 m. 58 s.	144	59	51·4	−0	45	30 0

The following observations have been made on the dates named:—

		R. A. h.	m.	s.		Dec. °	′	″
Sept. 18·01062	Greenwich M. T.	11	30	58	+	1	22	24
„ 19·001666		11	21	59	+	0	24	38
„ 19·99437		11	15	24	−	0	25	32
„ 22, noon, Palermo		11	5	39	−	1	51	—
„ 28, 17h. 15m. Vienna M.T.		10	45	52	−	5	51	—

A NOTE from Mr. Proctor, explaining his mistake as to the possible identity of the new comet and the comet of 1843 (a mistake which appeared in a portion of our last issue) was published in the *Daily News*, *Standard*, *Morning Post*, *Daily Chronicle*, and *Daily Telegraph* of Saturday last. The correction was sent to the *Times* also, but did not appear there. It was not to be expected that it would; the *Times* does not correct its own mistakes, whether in science or politics. Why should it help to correct other folks'?

THE *Daily News*, in an article on "whistling," which it argues is done only, as the poet says, "for want of thought," remarks that Athene threw away the flute (probably the Indian nosepipe), because it distorted *his* features. Athene is generally supposed to have been a lady. Alcibiades said no man of sense would play the flute, because his best friend would not know him when he was performing on that instrument, with which, therefore, he would have nothing to do.

BUT "Cosmopolitan," in the *Globe*, points out that the fishermen of Ceylon whistle for their bait. The fisherman runs down some yards to meet an advancing wave, agitates the water, and probably some sand also, with the fingers of one hand, and then runs backwards, whistling all the time. When the wave retires he follows its retreat, and almost invariably finds a long worm on the sand at the point where he had agitated the water. The opinion of the natives is that the whistling acts as a charm to the worm, and causes it to rise to the surface.

MR. PERCY RUSSELL has discussed in these columns the meat supplies of the world, and has shown that in Australasia there is abundant provision for our present wants. But Dr. Drysdale, as reported by the *Squire*, gives much fuller promise; for he says there is a never-failing supply in Australia and "several other hemispheres"—possibly in Venus, Mars, or Mercury.

CONSIDERING the high tides which we have recently had, it is not much to be wondered at that the inhabitants of South Belgravia should have been considerably alarmed about the risk of inundation, for there are parts of the river wall, at the end of the wharves in the Grosvenor-road and at the bottom of St. George's-square, where, should the river rise a few inches higher than it did last September, a very serious inundation would take place. A public meeting of the inhabitants of South Belgravia will before long, we understand, be convened to urge on the Government the necessity for the immediate raising of the river wall in these places.

AN electric launch named the *Electricity* has made a trial trip on the Thames, propelled by forty-five accumulators. The trial is considered to have been a successful one, and we shall doubtless soon hear more of this application of electrical power.

THE first Golden Eagle which has been seen in Argyleshire for many years appeared last week. It was seen by a keeper on the Strachur estates near Loch Fyne. Is it necessary to ask what that keeper did? The bird was a rare and interesting specimen; so, of course, he shot it.

AND yet they doubt whether modern so-called civilised nations are descended from savage races.

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The quantity of gas used in London last year, according to the analysis of the London gas companies' accounts, prepared by Mr. John Field, was, in round numbers, 20,230,000,000 cubic feet, which is equal to a bulk of one mile square by 726 ft. high, and its cost to the public was £2,911,000.

The proposition to hand over Kew Eyot to a speculator is, of course, an atrocity of which only such beings as Commissioners of Woods and Forests or Thames Conservators could be guilty. But a counter proposition to hand it over to Sir Joseph Hooker's tender mercies is infinitely worse. Judging from the development of Kew Gardens under his suave administration, the eyot would presently be surrounded by a wall 15 ft. high, with one gate (6 ft. by 2 ft.) to admit visitors between two and five p.m., subject to the courteous admonitions of a red-striped functionary, apparently selected for his fitness to terrify children. Walking-sticks and reticules rigorously excluded.

M. Fonsegrive discusses, in the *Revue Philosophique*, the various meanings which have been assigned to the words analysis and synthesis. He shows that Newton, who said analysis means passing from effects to their causes, was right,—"that is *comprehensive analysis*": but Hooke, who said that analysis consists in passing from causes to their effects, was not wrong—for the comprehensive analysis of Newton is also *extensive synthesis*. It is, however, more important to make correct analysis or synthesis than rightly to define either.

M. P. de Tchihatcheff contends that the great deserts of Africa and Asia are not sea-beds, recently laid dry, but have been upraised at remote geological epochs, their sands being not of marine origin, but the product of rocks disaggregated by winds, changes of temperature, and so forth. The Asiatic deserts are far older than Sahara.

The Telephone in America.—According to a report presented to the recent telephone convention held in Boston, there are about 60,000 to 70,000 subscribers in the United States. In New York there are 2,873, and the smallest number in any one place is 10. There is a steady and continued growth all over the country.

The sugar-beets on the Continent have been attacked by a new disease.

The female woodcock in America has been observed by Mr. F. L. Harvey to carry away her young from danger between her feet.

The author of "Insect Variety" is preparing for publication a Table of Sun-spots and Earthquake Phenomena, "by means of which many public calamities may be predicted." Public institutions or private individuals desirous to assist are invited to subscribe. Address—but no, our advertising columns are open. Zadkiel's Almanac also predicts public calamities, price 6d., and is likely to be equally trustworthy.

A joint annual meeting of the two Anti-Vivisection Societies took place, says the *Quarterly Journal of Science*, at the end of August. There were present, "besides the Rev. Mr. Grove and the inevitable Mr. Jesse, no fewer than three men, four women, a small girl, and four reporters." The A. V. S. Societies are looking up.

At Princeton, N.J., a splendid new equatorial has been set up at the Halsted Observatory. Its object-glass is 23 in. in diameter, and it has a focal length of 30 ft. Professor Young, one of the most skilful astronomers of the day, has charge of the observatory.

Search Lights for the Navy.—The British Electric Light Company have received an order from the Admiralty to supply the following search-light apparatus for war vessels:—Eight large 40,000 candle-power Gramme machines, eight projectors, and eight hand-lamps, as used in the late war.

At a meeting of the Birmingham School Board last week, the Education Committee submitted a memorial to the Privy Council seeking the power for School Boards to establish training colleges for teachers owing to the insufficient accommodation in the present training colleges. The memorial was generally approved, but referred back to the Education Committee for a slight alteration, after which the Board will appoint a deputation to wait upon the Education Department.

During the last voyage of the steamship *Kirkheaton*, Captain Cook, from Goole to Bruges, when she was but a few miles from the mouth of the Humber, bearing towards the Newark lightship, a violent thunderstorm broke over the ship. In the course of it a violent shock was experienced, as if she had been in collision with another vessel. The portion of the crew who were below ran on deck to see what had happened. It is believed that, though no damage was done, the vessel must have been struck in some way or other by a flash of lightning.

Fatal Accident.—The *Standard's* New York correspondent says:—"A workman who was repairing a lofty Brush light here received the electric current which was supplying forty lights. It passed through the man, who fell dead, the body dangling among the telegraph wires below. The hands were seared, and the face bore the expression of intense agony."

Electric Railways.—The number of railways to be worked by electricity is now considerable. Those which are working, authorised, or in course of construction, show a total length of about 100 miles. The lines actually at work are those of Lichterfelde, 1·56 miles, and that from the Spandeur Bock to Charlottenberg, near Berlin; the Port Rush to Bush Mills, in the North of Ireland, about 6·5 miles; and also in Holland, one from Zandvoort to Kostverloren about 1·3 miles long. Among lines authorised or in construction, the following are noted:—In Austria, the Mœdling line, near Vienna, 1·5 miles, to be constructed by the Southern Railway Company there. In Germany, the line from Wiesbaden to Nürnberg, 1·3 miles, and that from the Royal mines of Saxony to Zankerode. The line under the Thames connecting Charing-cross and Waterloo stations will be about three-fourths of a mile; also a line in South Wales thirty-seven miles, for which the power will be derived from fall of water. In Italy, Turin, and Milan will soon begin the construction of electric tramways. In America, the Edison Company have arranged for the working of 80 kilomètres on one of the great lines from New York. Another small line, 1·1 miles, is to be made at St. Louis, in Missouri, by Mr. Heisler.

THE SUN AND THE BROOK.

By Richard Jefferies.

Author of "The Gamekeeper at Home."

THE sun first sees the brook in the meadow where some roach swim under a bulging root of ash. Leaning against the tree, and looking down into the water, there is a picture of the sky. Its brightness hides the sandy floor of the stream as a picture conceals the wall where it hangs, but, as if the water cooled the rays, the eye can bear to gaze on the image of the sun. Over its circle thin threads of summer cloud are drawn; it is only the reflection, yet the sun seems closer seen in the brook, more to do with us, like the grass, and the tree, and the flowing stream. In the sky it is so far, it cannot be approached, nor even gazed at, so that by the very virtue and power of its own brilliance it forces us to ignore, and almost forget it. The summer days go on, and no one notices the sun. The sweet water slipping past the green flags, with every now and then a rushing sound of eager haste, receives the sky, and it becomes a part of the earth and of life. No one can see his own face without a glass; no one can sit down and deliberately think of the soul till it appears a visible thing. It eludes—the mind cannot grasp it. But hold a flower in the hand—a rose, this later honeysuckle, or this the first harebell—and in its beauty you can recognise your own soul reflected as the sun in the brook. For the soul finds itself in beautiful things.

Between the bulging root and the bank there is a tiny oval pool, on the surface of which the light does not fall. There the eye can see deep down into the stream, which scarcely moves in the hollow it has worn for itself as its weight swings into the concave of the bend. The hollow is illumined by the light which sinks through the stream outside the root; and beneath, in the green depth, five or six roach face the current. Every now and then a tiny curl appears on the surface inside the root, and must rise up to come there. Unwinding as it goes, its raised edge lowers and becomes lost in the level. Dark moss on the base of the ash darkens the water under. The light green leaves overhead yield gently to the passing air; there are but few leaves on the tree, and these scarcely make a shadow on the grass beyond that of the trunk. As the branch swings, the gnats are driven further away to avoid it. Over the verge of the bank, bending down almost to the root in the water, droop the heavily-seeded heads of tall grasses which, growing there, have escaped the scythe.

These are the days of the convolvulus, of ripening berry, and dropping nut. In the gateways, ears of wheat hang from the hawthorn boughs, which seized them from the passing load. The broad aftermath is without flowers; the flowers are gone to the uplands and the untilled wastes. Curving opposite the south, the hollow side of the brook has received the sunlight like a silvered speculum every day that the sun has shone. Since the first violet of the meadow, till now that the berries are ripening, through all the long drama of the summer, the rays have visited the stream. The long, loving touch of the sun has left some of its own mystic attraction in the brook. Resting here, and gazing down into it, thoughts and dreams come flowing as the water flows. Thoughts without words, mobile like the stream, nothing compact that can be grasped and stayed: dreams that slip silently as water slips through the fingers. The grass is not grass alone; the leaves of the ash above are not leaves only. From tree, and earth, and soft air moving, there comes an invisible touch which arranges the senses to its waves as the ripples of the lake set the sand in parallel lines. The grass sways and fans the reposing mind; the leaves sway and stroke it, till it can feel beyond itself and with them, using each grass blade, each leaf, to abstract life from earth and ether. These then become new organs, fresh nerves and veins running afar out into the field, along the winding brook, up through the leaves, bringing a larger existence. The arms of the mind open wide to the broad sky.

Some sense of the meaning of the grass, and leaves of the tree, and sweet waters hovers on the confines of thought, and seems ready to be resolved into definite form. There is a meaning in these things, a meaning in all that exists, and it comes near to declare itself. Not yet, not fully, nor in such shape that it may be formulated—if ever it will be—but sufficiently so to leave, as it were, an unwritten impression that will remain when the glamour is gone, and grass is but grass, and a tree a tree.

HOW TO GET STRONG.

(*Continued from page* 233.)

TO STRENGTHEN THE UPPER BACK AND SHOULDERS.

IN our last, we considered the muscles in front of the chest—or, technically, the pectoral muscles. We have now to consider how the muscles of the upper back and shoulder—the dorsal muscles—may be strengthened.

Here, for the first time in these papers, we are considering muscles which are more apt to be over-developed, relatively, than to have insufficient amount of exercise. It is much more common to see men round-shouldered in consequence of undue development of the muscles of the upper back, than to see the muscles of the arms or legs, or of the front of the chest or abdomen, too fully developed. The deformity—for such it unquestionably is—may, indeed, generally arise rather from insufficient development of other muscles than from excessive use of the dorsal muscles. Still, it remains the case that probably of all the muscles of the body those which in this country are generally attended to best are the muscles of the upper back and shoulders.

The reason of this is that the favourite forms of exercise in this country are such as encourage the development chiefly of these muscles. "Rowing," says Maclaren, "is the chief of all our recreative exercises; no other can enter the lists against it; in fact, it has collected and concentrated in itself all the attractions and all the emulative distinctions of all others." Next to rowing, boxing used to be a favourite exercise, and it still holds a place in our gymnastic system. Now, boxing is good for the chest and pectoral muscles, and in rowing the muscles of the legs *may* be very actively employed. But in both exercises, and in others which are in high esteem in this country, the dorsal muscles are actively used. In rowing especially this is the case—insomuch that you can tell any rowing-man when his shoulders are stripped, and some rowing-men even when they wear their usual clothing, by the way in which the muscles of the upper back and shoulders outweigh, so to speak, the muscles of the front of the chest.

The idea that rowing expands the chest is as absurd in reality as the cognate mistake that it specially strengthens the biceps muscles. Yet both mistakes are so common that if you tell most rowing men that their exercise is better for the shoulders than for the chest, better for the forearm than for the upper arm, and better (if properly managed) for the legs than for the arms, they will think you are laughing at them. Yet it has been demonstrated by actual measurement that this is the true state of the

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case. "Rowing," says Maclaren, "gives employment to a portion of the back, more to the loins and hips, and most of all to the legs, but it gives little to the arms, and that little chiefly to the forearm; and least of all to the chest." He was speaking, however, of rowing in light racing-boats. In ordinary river-boats, the forearms get a good share of work, and the dorsal muscles probably get more work than the legs. As for the chest, it gets so little work that it seems, in the case of many persons who devote a great deal of their time to rowing, actually to shrink.

We cannot direct attention too strongly to what Maclaren has said on this point, because what he says is true of every kind of rowing, from pulling a heavy, "inrigged tub," to rowing in the lightest outrigged craft which has ever yet been constructed. "*The part of the body which receives the smallest share of the exercise in rowing is the chest,*" he says; "it has little or no employment in the muscular effort required for the propulsion of the boat; and *this is impressively evident in the results. Not only does the chest make no advance in development in this exercise, but if it be exclusively practised, an absolutely depressing effect is produced.*" No single result of recreative or systematical exercise may be more fully substantiated than this. Take any crew in the University, just as it stands, and at any stage of its practice, and it is possible, in a given space of time, by varied systematised exercise, to increase the chest of every man by a given number of inches, with a proportionate development of power; let this cease, and exclusive rowing exercise be resumed, and the progressive development of the chest will also cease; nay, its muscles will lose their condition, and their power will decline, in obedience to the organic law that power is in relation to employment, for here they have virtually none. I could at this moment point to men who have had rowing for exclusive exercise since they came to the University,—men endowed with an organisation capable of the finest development, whose chests have been almost stationary for years, the years during which they should have made the greatest advancement—who have now, in fact, the same development in this region which they brought from school, lingering at thirty-six or thirty-seven inches, when forty or forty-one was fairly within their reach.

We shall illustrate our next article with two pictures, one from a photograph of a successful oarsman, the other showing what properly-proportioned chest, arms, and shoulders should be like.

(*To be continued.*)

SECONDARY BATTERIES OR ACCUMULATORS.

ONE of the greatest marvels of the age is the immense interest attaching to this series of apparatus. In a sense, the excitement consequent on the demonstration of the practicability of electric lighting is less, inasmuch as for several decades past that subject has been periodically revived in the minds of scientific men. Notwithstanding the fact, however, that secondary batteries are now before the general public for the first time, it must not by any means be supposed that they are novelties to the better-informed physicists.

It is not necessary, nor would it be advisable, for us to go back eighty or more years to lay before our readers the history of the secondary battery and the principles that govern it. We will pass over the preliminary but important work of Galvani, Volta, Ritter, and a number of other devotees, pausing to say a word or two about the celebrated gas battery of Sir William Grove, which may be said to embrace the fundamental principles of secondary batteries.

"In this battery each cell consists of a vessel containing acidulated water, in which the lower portions of two platinum plates are immersed, their upper portions being surrounded, one by oxygen and the other by hydrogen, enclosed in inverted tubes. Each tube has a platinum wire passing through its upper end and connected with the enclosed plate. These wires are the terminals of the separate cells, and in combining a number of cells into a battery, the oxygen tube of one cell must be connected with the hydrogen tube of the next. When the circuit is completed a current circulates, opposite to that which would have evolved the gases from the acidulated water, and the quantity of gas in the tubes diminishes. Chemical combination, in fact, goes on between the two gases of any one cell through the intervention of the acidulated water. The plates employed in this battery are usually covered with a deposit of finely-divided platinum, which increases the rapidity of the action."* This late feature is somewhat important. With a gas battery of fifty pairs, Grove produced electric lights, effected various chemical decompositions, &c.

To M. Gaston Planté, however, more than to any other man, justly belongs the first place of honour in this branch of scientific labour. It is a most remarkable fact that the very thing which the general body of practical workers regard as an obstacle other men take up, and by its means confer an immeasurable boon on humanity. It was so in the case of M. Planté. Electricians had striven very hard to rid themselves of the troubles arising from what is called the "polarisation of the battery." For this purpose the Daniell cell was invented, which to this day stands forward as pre-eminently the best for the ordinary requirements of telegraphy. Polarisation results in the deposition of one or more of the constituents of the liquid in the cell on one of the plates. In the simple cell, with zinc and copper immersed in acidulated water, the zinc is oxidised, and converted into zincic sulphate, while hydrogen gas is deposited on the copper plate. In a short time this hydrogen becomes a powerful source of an opposing current, the cell being then useless. Substituting a simple metallic salt for the acid, the metal is, generally speaking, deposited on the copper, or whatever substance may constitute the negative plate; the acid portion of the salt combining with the zinc, or positive plate. But the same thing which takes place in the battery cell may be made to occur in any part of a battery circuit. Here, then, lies a part at least of the action of Grove's Gas Battery. A current, in passing through the water, decomposed it, the two constituent gases—oxygen and hydrogen—accumulating, the former at the positive electrode, or point of entry of the current, and the latter at the negative electrode, or point of exit.

This principle may be seen elsewhere, for wherever we pass electricity through a compound liquid, a change in the chemical relationship may be found, and this change will always be such as will tend to generate an electric force opposite in direction to that which brought about its existence. Such, then, is "polarisation." Briefly defined, we may say that "polarisation is the electric re-action at the poles or electrodes of a cell, and is of the nature of a counter-electromotive force." How M. Planté made use of this polarisation, we will say in our next.

* Deschanel's "Natural Philosophy."

THE POPULAR NOTION OF A HORSE TAKING A LEAP.
IN THE SCENE BELOW CAN BE NOTICED THE DIVERS POSITIONS TAKEN BY HORSES AT AND OFF A JUMP.
THE ACCEPTED IDEA — UP TO THE PRESENT DAY — OF A HORSE AT FULL SPEED.
IN THE MANY GALLOPING POSITIONS BELOW IT WILL BE SEEN THAT NOT IN ONE SINGLE INSTANCE DOES A HORSE APPEAR WITH ALL FOUR LEGS EXTENDED AT ONCE — AT GALLOP.
THE PICTURE REPRESENTS A HUNTING EPISODE. FULL CRY. EVERYTHING IS ON A RUSH. HORSES GOING AT UTMOST SPEED. IT IS A CAREFUL NATURAL REPRESENTATION. THE MOTIONS ARE GIVEN AS THEY ARE IN NATURE. ALL POSITIONS ARE COPIED FROM Mr. MUYBRIDGE'S PHOTOS. ALL OF THE GALLOPING MOVEMENTS COVER BUT ONE STRIDE OF ONE HORSE

SCIENCE OF THE HORSE'S MOTION.

THE remarkable pictures of the horse in motion, as revealed by Mr. Muybridge's instantaneous photographs, taken in California, at the instance of Governor Stanford, show that the impressions produced upon the human mind through the eyes, in closely watching the motions of a horse when running a certain distance, are very different from the impressions which will be made during the same run upon a highly sensitive photographic plate.

In a recent number of the *American Queen*, we find a peculiar drawing, which is of value as illustrating at one view these extraordinary differences of impressions.

The two upper figures show the impressions ordinarily made upon the mind's eye by the horse and rider in the acts of running and leaping. Here we have grace, vigour, and strength very well exemplified. The smaller figures below are mostly made from the instantaneous photographic pictures before mentioned, with this important qualification, however, that while many of the positions of the horses are correctly taken from the photographs, the positions of the riders are, we suppose, the work of the fancy of the artist. There is an old adage, that things are not

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what they seem to be; and it is proverbial that the eye of man is an organ that is easily deceived. It is certainly, at present, an agreeable kind of illusion which makes us see the horse as we do see it, and not as the photo plate sees and records it.

It is possible, however, that in the future, now that the photograph points out so many forms and motions that have escaped our attention, we may be able to sharpen our eyes, and hereafter to see things about the horse to which heretofore we have been blind. And it may come to pass that all those singular attitudes shown in the lower part of our illustration, which now seem so absurd and awkward, will become endowed with grace and beauty in our minds, while the old forms will be dismissed as untruthful and therefore ugly.—*Scientific American Supplement.*

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XI.—PA-RAMESES (*Continued*).

THE letter last quoted, announcing the advent of Menephthah at Pa-Rameses, was addressed by the Scribe Amenemapt to the Scribe Panbesa. We are now about to read a letter from the Scribe Panbesa to the Scribe Amenemapt. This document also forms part of No. III. of the Anastasi papyri. It has been translated into French by MM. Chabas (1864) and Maspero (1872); and more recently into English by the late C. W. Goodwin (see "Records of the Past," vol. vi., 1876). It was also in part deciphered by the Rev. J. Dunbar Heath as far back as 1855.

The letter of Panbesa is a very remarkable production. It is, in the Egyptian sense, a poem. That is to say, it is phrased and divided into short lines like the Hebrew Psalms. Red dots are placed above certain words to show where the lines begin. The style is thoroughly Oriental; and, notwithstanding the ages which separate us from the literary public of the XIXth Dynasty, we are yet able to appreciate its florid and somewhat hyperbolical beauty. By the Egyptians of that time, it was evidently regarded as a classic; the document in the Anastasi papyri forming part of a transcribed collection of choice pieces. Also, it was not a *bond-fide* letter, in the sense of a private communication. It was a literary letter; a composition addressed, by way of dedication, to a superior, and intended for circulation among people of culture. It is not, however, as a specimen of Egyptian style, but as a topographical document, that the letter of Panbesa is especially valuable to our inquiry.

The document, I should observe, is greatly mutilated; and most of the fruits, flowers, and fishes mentioned in the course of the poem are unknown to us under their Egyptian names. Where these are explained, the explanations are chiefly borrowed from Dr. Birch's foot-notes to Mr. Goodwin's translation. The text is based principally on Mr. Goodwin's version, with some aid from that of Professor Maspero. The date of the composition may be confidently assigned to the reign of Rameses II.; probably towards the end of his long career, the writer being the same scribe, Panbesa, with whom the same scribe, Amenemapt, was in correspondence during the reign of Menephthah, the successor of Rameses II. The poem would seem to have been composed in celebration of the Royal visit to Pa-Rameses.

The Letter of Panbesa.

The Scribe Panbesa greets his Lord, the Scribe Amenemapt, to whom be life, health, and strength!
This is sent for the information of my Lord.
This is for my Lord's pleasure.
When I arrived at Pa-Rameses Mer-amen
I found all in good order, beautiful, peerless;
Like the foundations of Thebes,
Where to live is happiness.
Its fields are filled with delicious things;
It is provisioned daily [a] with good food;
Its tanks are stocked with fish, and its
Ponds with water-fowl;
Its meadows are fat with pasture;
With the tufted *Ates* [b] blossom,
And the *Tenraka* [c] plant, sweet like honey,
Which grows in the fields of the water-wheels.
Its threshing-floors are piled to the skies
With wheat and barley.
Leeks grow in the beds;
Gourds on the trellis;
Grapes, and olives, and figs in the orchard.
There is sweet wine of Khemi [d]
Far above honey.
There are red Utu [b] fish from the river of lilies;
Speckled mullet from the tanks;
X'eprun [b] fish from the river Puharta (Euphrates);
Hanata [b] fish from the canals of Aanekht [e].
The Pool of Horus gives salt;
Lake Pahura [f] gives nitre.
Its galleys come and go in the port.
Riches and provisions abound daily therein.
Gladness abides with those who dwell in it;
None dispraise it.
The lesser folk are there equal with the great folk.
Come, let us celebrate its heavenly festivals
And its season-holidays!
The papyrus-marsh is gay with *Menhu* [g] blossoms.
The Pool of Horus is covered with flowers of *Asi* [h];
There are *Sabora* [b] flowers from the Arboretum;
Garlands from the vineyards;
Wild-fowl from the inundated lands.
The coast-men of the sea bring eels, and the fish *Atu* [b].
The maidens of Aanekht [i] are in holiday attire every day.
Their locks are redolent of perfumed oil;
They stand in their doorways,
Their hands full of nosegays
And of green boughs of Pa-Hathor [j],
And garlands of Lake Pahura,
On the day of the entry of
Ra-user-ma Sotep-en-Ra,
The Mentu [k] of the Two Lands [l],
The morning of the Feast of Choiak [m]!
And every man is like his neighbour,
Making his petition.
Oh, the sweet drinks of Aanekht!
Its pomegranate-wine is like flame;
Its syrups are flavoured with
Carob-fruit surpassing honey.
Beer of Kati is brought to the port;
Wine comes from the vineyards;
Sweet oil from Sakabami; [n]
Garlands from the arbours.
The sweet singers of Aanekht
Are of the school of Memphis. [o]
Joy reigns and prevails there
Uninterruptedly.
Ra-user-ma Sotep-en-Ra
(To whom life, health, and strength!).
The Mentu of the two Lands,
Rameses Mer-Amen
Is its God!

Notes.—[a] Meaning that it had a daily market. [b] Unknown. [c] Probably cucumber, or melon. [d] Egypt. [e] The canals of the neighbourhood; Aanekht being one of the names of Pa-Rameses. [f] One of the Bitter (or natron) lakes in the Isthmus of Suez. [g] A flower with red and violet petals. [h] Apparently a kind of water-plant. [i] Aanekht, *i.e.*, Pa-Rameses. See above. [j] The abode, or temple, of Hathor; meaning, probably, boughs from the sacred enclosure of that temple. [k] *Mentu*, the Mars, or war-god, of Egypt. [l] Upper and Lower Egypt. [m] Choiak, the fourth month of the season of inundation. [n] Unknown locality. [o] The *Memphi'ides puellæ* of the Latin authors.

Now the important points to be noted in this little poem are :—

1. That if Pa-Rameses was supplied with rare fish from the Euphrates, it must have been in some kind of communication with the Red Sea.

2. That it was in the neighbourhood of a piece of water called *Shet-Hor*, or the Pool of Horus.

3. That it was also near one of the bitter lakes, the water of which is impregnated with nitre (Natron).

4. That it was a place accessible to shipping.

5. That the local deity of the town was Rameses II.

This last point—and it is a strong one—coincides with all the former evidence. There were temples in Pa-Rameses to other gods; but the supreme deity of the place was its royal founder.

The mention of Shet-Hor is also very important, when taken in connection with another mention of this piece of water which occurs in a celebrated stone-cut inscription on the walls of a small court on the south side of the Great Temple at Karnak. This inscription (which I shall have occasion to examine more particularly by-and-by) records how a great invasion of the Mediterranean races took place soon after the accession of Menephthah, and how the king fortified Heliopolis and Memphis, and "established outposts before *Pa-Baris* (Bubastis), in the vicinity of the canal *Shakana*, to the north of *Shet-Hor*."*

I may here observe in passing that I have not quoted all the instances in which Pa-Rameses is mentioned in the papyri of this period; but I have quoted all that are noteworthy. The remainder are mere incidental allusions, invocations to the gods of the place, addresses upon letters, and the like.

Of Pa-Tûm, or Pa-Toom—which was, both strategically and historically, a much less important place than Pa-Rameses—we find but one unmistakable mention in the papyri of the period. The document in which this mention occurs also forms part of the Anastasi collection (No. VI.). It dates from the VIIIth year of Menephthah, and purports to be a report written by some captain of the frontier guard, relating how certain Shasu (Bedaween) had sought and received permission to graze their herds in the well-watered pastures about Pa-Tûm.

"We have done all that was needful in suffering the Shasu tribes of Adumah (Edom) to pass the fortress of Menephthah Hotepherma (to whom be life, health, and strength !) on their way to the Pools of Pa-Tûm of Takou, that they may feed their cattle in the great pasture-lands belonging to the king (to whom be life, health, and strength !), the Sun of all Countries, in the year VIII. . . . their names have been entered on the list. . . " &c., &c.

To this I may add (not having Mariette's "Denderah" at hand, and relying on the authority of M. l'Abbé Vigoureux), that the name of *Pa-Tûm*, designated as a town on the Eastern frontier, appears in the great geographical lists of the Temple of Denderah.

Lastly, Herodotus—who is always to be relied upon when speaking from personal observation, and not repeating tales told to him by *cicerones* and priests—not only names the town of Pa-Tûm, but with great precision describes its position in relation to the city of Bubastis and the canal mentioned in connection with Bubastis in the great lapidary inscription at Karnak before referred to. He is writing about the canal, which he mistakenly attributes to Nekau, the son of Psammetichus, whereas it was actually begun and carried to a considerable distance by Seti I. "This prince (Nekau)," he says, "was the first to attempt the construction of the canal to the Red Sea—a work completed afterwards by Darius the Persian—the length of which is four days' journeys, and the width such as to admit of two triremes being rowed along it abreast. The water is derived from the Nile, which the canal leaves a little above the city of Bubastis, near Patûmus, the Arabian town, being continued thence until it joins the Red Sea." (See Rawlinson's "Herodotus," book ii., chap. 158.)

That the Patûmus of Herodotus was the Egyptian Pa-Tûm, and that the canal here described is the canal of the Karnak inscription, are facts which admit of no shadow of doubt; and that Pa-Tûm and Patûmus are the Pithom of the Bible is, I think, equally certain. Sir Gardner Wilkinson, in his foot-note to Rawlinson's translation of this passage, remarks :—"Herodotus calls Patûmus an Arabian town, as lying on the East side of the Nile" (vol. ii. p. 206); and, in point of fact, every Nile tourist to this day follows the example of Herodotus in thus loosely describing sites to the east of the river. The desert on the right bank is always the Arabian desert, and the desert on the left bank is always the Libyan desert. Also, this part of the frontier-land, including the old Nome of Kosem, or land of Goshen, was called in the time of Herodotus by the more modern name of the Arabian Nome—meaning the Nome farthest east, in the direction of Arabia. Neither Patûmus, nor Bubastis, nor the canal was Arabian in any other sense.

* For translations of this inscription, see "The Invasion of Egypt by the Greeks," by Dr. Birch, "Records of the Past," vol. iv., and Chabas's "Antiquité Historique." Paris. 1873.

Mr. Stephen S. Haight says that last year he saw a house struck by lightning, and the eave plates completely destroyed. No other damage was done, and, beyond a slight shock, the family sustained no harm. At both ends of the house there was a lightning conductor, but neither of them bore any mark of the discharge. In front of the house was the pole of a telegraph line, stayed by a wire to the gate-post. The stay wire was melted, and the gate and gate-post damaged. A deep furrow also ran from the gate to the brick sidewalks, where it terminated in a hole. A tree in the course of the furrow was killed. He (the speaker) had no doubt that the damage was due to the stay wire, and, moreover, that the attractive power of the hemlock tree is greater than that of the deciduous trees.

Camels live from forty to fifty years; horses average from twenty-five to thirty; oxen, about twenty; sheep, eight or nine; and dogs, twelve to fourteen. Concerning the ages attained by non-domesticated animals, only a few isolated facts are known. The East Indians believe that the life period of the elephant is about 300 years, instances being recorded of these animals having lived 130 years in confinement after capture at an unknown age. Whales are estimated to reach the age of 400 years. Some reptiles are very long-lived, an instance being furnished by a tortoise which was confined in 1633 and existed until 1753, when he perished by accident. Birds sometimes reach a great age, the eagle and the swan having been known to live one hundred years. The longevity of fishes is often remarkable. The carp has been known to live 200 years; common river trout, fifty years; and the pike, ninety years, while Gesner—a Swiss naturalist—relates that a pike caught in 1497 bore a ring recording the capture of the same fish 267 years before. Insects are very short-lived, usually completing the term of their existence in a few weeks or months. Some even die upon the very day of entering on their new life. As a general rule not to be applied too closely, larger types of animals live longer than smaller.

XUM

CLOUDS IN THE AIR.

By the Editor.

(*Continued from page* 279.)

IN our last we considered the effect of foreshortening on rounded clouds; we have now to consider how those clouds which are really long, parallel bands appear, as seen from different points of view. As before, we imagine clouds and arrangements of clouds altogether more regular than in nature. In fact, it is only thus that the problems we have to deal with can be effectually treated; for if we gave to the clouds we considered peculiarities of shape such as actually exist in nature, it would be impossible to distinguish properly the effects of such peculiarities from the effects due to the position of the clouds, or cloud-bands, with respect to the observer.

Let us suppose, in the first place, that the clouds are arranged in a series of parallel bands, as shown in Fig. 1. These clouds may be supposed to be roughly circular in section athwart their length. The portion of sky supposed to be shown in the figure may be regarded as about the

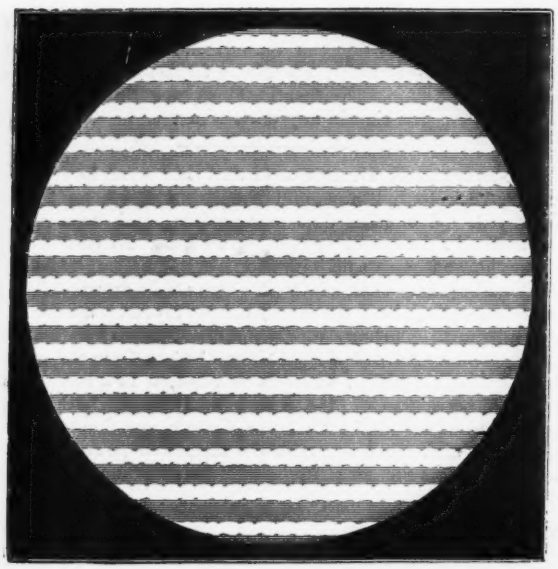


Fig. 1.

same as is shown in the three last figures of the last article (pp. 278 and 279), or about forty-five degrees from the zenith, all round. [But later, when we have to consider the effects produced by foreshortening near the horizon, we may also regard the picture as showing the whole atmosphere above a place.]

In Fig. 2 the cloud-bands, shown in Fig. 1 as they actually are, are shown as they appear to an eye placed immediately beneath the region represented. In other words, the centre of the figure represents the point over head, while the circumference represents a circle on the sky about forty-five degrees above the horizon. We see that the bands, which are really straight, appear to the eye to be curved. It may be noticed here that this figure enables us also to recognise the real meaning of the curved outline often seen in the case of a cloud covering the region over-head. Such a cloud will often be seen to have an outline like an arch, drawing close to the horizon on either side, and rising high above the horizon in the middle—having, in fact, the same form as the outline of one of the bands shown in Fig. 2, about midway been the centre and the edge. We see from Fig. 1 that this does not really show, as it seems to do, that the cloud is higher in the middle than at either side, but that the part of the edge which seems highest is nearer than the part which looks lower. Thus when a part of the under edge of a cloud-bank which we are approaching seems higher than the rest, we may infer that that part is nearer than the rest, and that

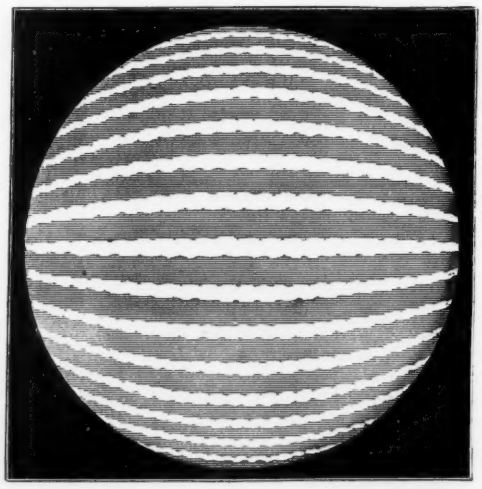


Fig. 2.

the sky overhead will soon (if we continue our advance) be free from clouds.

But while the parallel bands of clouds in the region overhead are thus modified in form, a much more marked change affects parallel bands lying near the horizon. Of course, the nature of the change depends in part on the direction of the bands. If we look towards that part of the horizon where the length of the cloud-bands is at right angles with the line of sight, we see the bands all brought together by foreshortening, so as to form a mass of stratus

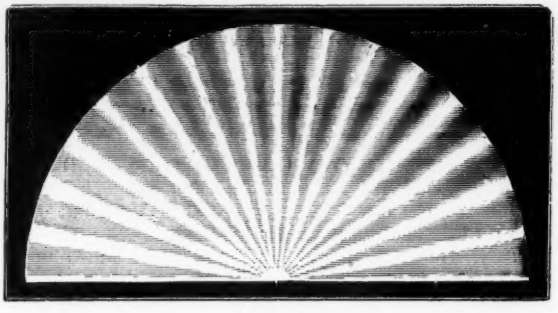


Fig. 3.

cloud, marked by a series of striations parallel to the horizon. If, on the other hand, we look towards the horizon in a direction parallel to the cloud-bands, a very different effect is produced. For then, by a well-known effect of perspective, the vanishing point of the parallel bands is on the horizon, and the clouds appear to radiate from the horizon, as shown in Fig. 3. It is obvious that the same effect will be produced whether we look in either of the two directions parallel to the cloud-bands—so that, when the whole of the visible sky is occupied by parallel

cloud-bands, there are two opposite points of the horizon, whence the clouds seem to radiate as shown in Fig. 3.

This, by-the-way, may help to explain a phenomenon which is often seen in tropical and sub-tropical regions, and which many observers seem to find perplexing—the existence at the same time of two sets of radiations from the setting or rising sun: for it is clear that if there are a series of straight and parallel rays from the sun near the horizon, these, like the parallel cloud-bands, would appear as a series of radiating beams, not only around the sun, but around the point of the horizon opposite to him.

(To be continued.)

THE MENACING COMET.

By R. A. Proctor.

IN my last I promised to show that this comet was seen where the comet of 1843 and 1880 could not have been seen—within two degrees. I am unable to do this, simply because there is every reason to believe that the comet which circled close around the sun on Sept. 17 is no other than our friend the Menacing Comet, come back not in fifteen years, as the *Spectator* said I said it might, but in less than two years and eight months.

I had corrected the proof of Prof. Smyth's letter on the comet, when it occurred to me (for my sins, no doubt) to make a rough calculation to see whether the orbit of the comet of 1843, seen from the earth's place on Sept. 18, crossed the position occupied by the comet on that day. I turned to my comet portfolio for my diagram of the orbit of comet 1843—or rather of the part of the orbit near the sun. Unfortunately, the arrow put in to represent the direction of motion had been carelessly drawn the wrong way, making the comet's course direct instead of retrograde, and thus altering the rising node into the descending node, and *vice versâ*. Having occasion for dealing rather quickly with the matter, I did not notice the error, and naturally came to an erroneous conclusion. The Editor of Knowledge remarks on this, that as I have no hesitation in pointing out the mistakes of others, I ought not to hesitate to point out my own mistake here. I tell him that the mistake arose from an exuberant anxiety to find out the truth, and tell it to readers of Knowledge. To this he replies, "That's all right, and now's your chance."

Seriously, I doubt whether many readers of Knowledge could have found out my mistake if I had chosen to leave it alone, but it is a clear duty to correct it. I wrote so soon as I had detected it (which was within an hour of my receiving first copy of Knowledge) to the six leading daily papers, to correct it, and, with one exception, they kindly gave me the opportunity.

Now to give a more correct account of matters:—

In Fig. 1, *c*, *p*, *g*, represents the perihelion portion of the orbit of the comet of 1843 around the sun S, ☊ being the rising node, ☋ the descending node. B D*i* is the orbit of the earth near the time of the vernal equinox, the position of which is indicated by the line S ♈. The places of the earth on Sept. 12, 17, 18, 19, 24, and 28, are shown at Q, A, B, C, D, and E respectively, and the direction lines from the earth on those days to the new comet are shown. (The last was added after the block had been already cut.) The plane of the paper is supposed, for convenience of reference,

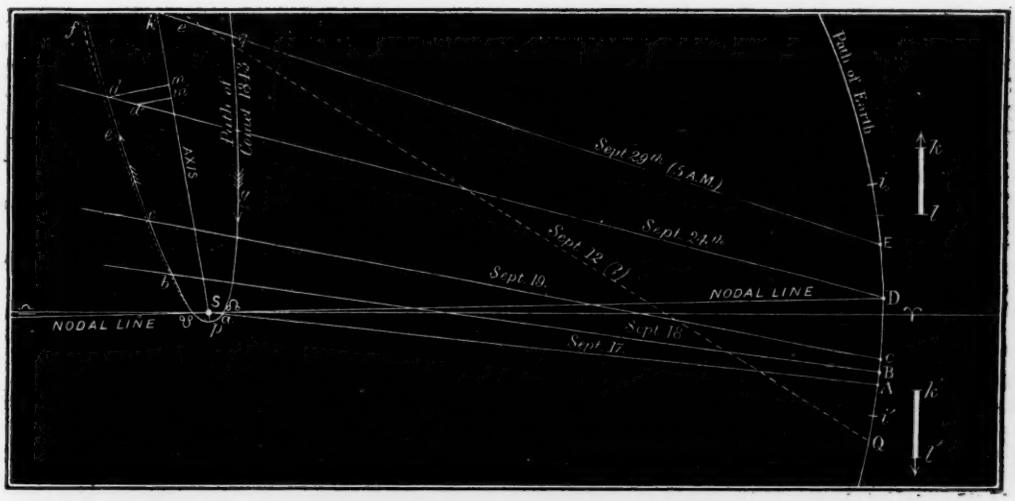


Fig. 1.

to correspond with the plane of the comet's orbit (the comet of 1843 is here referred to), and as the inclination of this plane to the ecliptic is about 35½ degrees, we must suppose *i* D *i'* to be inclined at this angle to the plane of the paper, *i* being above that plane by the distance *k l*, and *i'* below it by the equal distance *k' l'*. So much understood, the real direction of the lines Q*q*, A*a*, B*b*, C*c*, D*d*, E*e*, can be at once recognised. It will be seen that they agree with the observations recorded elsewhere for these respective dates.

These direction lines are so situated that they cut the plane of the orbit of the comet of 1843, in the points *a*, *b*, *c*, and *d*, lying on or very near the orbit of that comet. About the line *Qq* there is room for doubt, the telegram from M. Cruls at Rio Janeiro, having probably been incorrectly rendered.

The other observations (which are given in detail at p. 319) agree so well with the theory that the comet is moving in the orbit of the comets of 1843 and 1880 (at least in the part of the orbit near the sun, for at aphelion

the orbit has been entirely changed) as to leave scarcely room for any doubt that the comet has come back again long before it was expected—how soon to return yet again, and how soon to be finally absorbed by the sun, it were at present somewhat rash to say. But in another paper I have given some evidence which makes it *look* very much as though the end of the comet were not many *months* off.

In the next number I shall consider at length *how* that destruction of the comet, which now seems certain, is likely to be brought about, and with what probable effects on the sun and on this earth.

(*To be continued.*)

WHEN WILL THE COMET RETURN?

THE following, besides dealing with the comet, shows how the motion of a body moving in a very eccentric orbit in a given period may be conveniently dealt with.

I have shown in my "Geometry of Cycloids," that the common cycloid may be used for measuring the motion of a body in a very eccentric orbit around the sun—at least, this follows directly from what is illustrated there in the plate facing p. 209, where the curves for all orders of motion, from motion in a circle to motion in a straight line, under gravity, are given together. We see in that picture a certain curve for an eccentricity of nine-tenths, and this curve lies very close to the common cycloid representing the time-curve for motion in a straight line (eccentricity unity). How much nearer (in fact, not distinguishable from the cycloid), would be the curve for an eccentricity of ·99989 such as the comet of 1843 had! Supposing the period of the comet reduced to one year, the eccentricity, assuming the perihelion distance 500,000 miles, would be

$$\frac{92{,}500{,}000-500{,}000}{92{,}500{,}000}=\frac{920}{925}=\frac{184}{185}$$

Or the distance of focus from perihelion less than one-eighteenth part of that shown in the plate above mentioned. Thus the time-curve would lie only at one-eighteenth part of the distance from the cycloid at which the curve for eccentricity 9÷10 is placed, which yet lies so near the cycloid that, if drawn by itself, the eye could not recognise any difference from the true cycloidal figure.

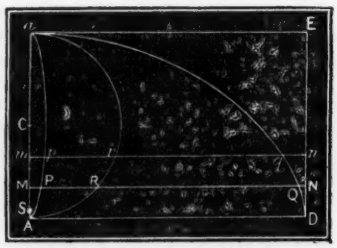
We may, then, for the purpose of a rough calculation such as I am about to make, take the cycloid for our time-curve after the manner described in Section VII. of my treatise on the Cycloid (the section explaining my "Graphical Use of the Cycloid and its Companion to determine the Motion of Planets and Comets").

The particular problem I wish now to deal with is this:—

Supposing the comet of 1843, which had been before moving in a period of more than 100 years, moved after 1843 in a period of 37 years, and after 1880 in a period of less than 3 years, so as to be back at perihelion on September 17th last, we might fairly infer it would not be at all unreasonable to infer that its next circuit would be accomplished in a year. Let us see, then, in what time, roughly, it would accomplish any distance from the sun on its elongated orbit.

Let APa represent the orbit of a comet, C its centre, AC=earth's distance, or 92,500,000, S the sun (AS= about 500,000 miles), AQD a half cycloid having aA for axis. Then, as I have shown in my "Cycloidal Geometry," if MPQN is drawn parallel to the base AD, the time in which the comet moves from A to P is to the time from A to a as QN is to MN.

Now, instead of drawing a cycloid aQD, with special care, to give us the times we want, suppose we make the calculations suggested by this construction. They are very easy.



Draw the circle a R A cutting MPQN in R. Then we know from the properties of the cycloid that

$$QN=\text{arc AR}-MR.$$

Suppose now AM=a third of AC; that being about the distance traversed by the new comet from S, as observed on Sept. 24.

Then $CM=\frac{2}{3}CA=\cdot66666\ldots$ if CA = 1; then from a table of natural cosines we find that arc AR, whose cosine is ·666... is one of 48° 12′; and (this we take out at the same time) the sine of this arc is ·745476. Turning next to a table of lengths of circular arcs, we find that the arc AR of 48° 12′ has a length of ·841249. Hence

$$QN=\cdot841249-\cdot745476=\cdot095773$$

And AD = semi-circumference = 3·141593.

Thus the time from A to P $=\frac{95773}{1570796}$ of half a year

$$=\frac{95773\times182\cdot625}{3141593}\text{ days.}$$

log. 95773 = 4·9812431
log. 182·625 = 2·2615602

7·2428033
log. 3141592 = 6·4971499

0·7456534 = log. 5·5674.

So that on this supposition as to the period, 5 days 13 hours 37 minutes would have been required to carry the comet over the distance actually traversed between Sept. 17 and Sept. 24, or in 7 days.

Let us try an orbit of different dimensions:—

Suppose Aa, the major axis, to be only one-half the earth's, so that by Kepler's Third Law the period, instead of being one year would be 1 year$\div 2^{\frac{3}{2}}$, or $1\div\sqrt{8}$ (we need not work out this value—as we shall obviously want the logarithm of the number of days in this new period, and this will be obtained by subtracting the logarithm of $\sqrt{8}$ from the logarithm of 182·625 already in use).

If now Am represent about a third of the earth's mean distance on this new scale, where AC represents half the earth's distance, then obviously $Am=\frac{2}{3}AC$; and $\frac{Cm}{AC}=\frac{1}{3}=\cdot3333\ldots$. Hence A$r$ is an arc of 70° 32′; $rm=\cdot942835$ (using table of natural sines as before); and arc rA=1·231039. Thus

$$qn=1\cdot231039-\cdot942835=288204.$$

or time

from A to $p=\frac{288204}{3141593}$ of $\frac{1}{\sqrt{8}}$ of 365·25 days.

Now,—

log 288204=5·4597000	½ log 8 =0·4515450
log 182·625=2·2615602	log 3141593=6·4971499
7·7212602	6·9486949
substract 6·9486949	

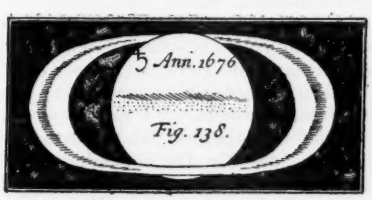
0·7725653=log 5·9233

This is still too small; so that if we are right in concluding from the observation at Vienna on September 24, that on that day at noon the comet had reached the position shown at *d*, Fig. 1, p. 327, the projection of which, S*m*, on the axis, *pk*, is about one-third of SD, then the period in which the comet will return to perihelion is certainly less than half a year. It is, however, to be noted that in that case the orbit has been reduced in width (minor axis), so that some such point as *d'* would be the true position of the comet on September 24, the projection of which, S*m'*, on *kp* is rather less than S*m*.

For my own part—so far as observations hitherto made enable me to judge—I expect the comet back in less than half a year.

WHO DISCOVERED THE DIVISION IN SATURN'S RING? *

EVERY one interested in the chronology of the discovery of Saturnian detail must thank you for your verbatim extract from the "Philosophical Transactions" at large on p. 307. My own quotation, on p. 295, was from the well-known abridgment of the "Philosophical Transactions," by Lowthorp, published in 1716, which is to be found in so many libraries. Reading the original article now, *in extenso*, it seems practically certain that your own interpretation of Ball's meaning (foot-note, p. 294) must be the correct one; and that both he and Wallis (who was, presumably, "the person to whom notice was sent hereof"), regarded the "Notches or Hollownesses, as at A and B," as evidence that there was a separate ring, or perhaps two veritable ansæ, on each side of the body of the planet. I have seen an engraving from a drawing by Huyghens, in which this form of duplication is considerably exaggerated in comparison with that shown in the figure you reproduce on p. 307. Certainly, if Ball had the slightest notion that two concentric rings surrounded Saturn, it is odd that he gave no indication of the division in his sketch.



If the accompanying *fac-simile* of Cassini's sketch of the planet, taken from Lowthorp, be worth reproduction, it will show at once how unmistakably the French astronomer saw the real interval separating the two rings, and, consequently, I would submit how truly he is entitled to the entire credit of the discovery. "Ball's division" is certainly a solecism, and should be banished from all future astronomical works, as descriptive of the space separating the two bright rings of Saturn. [Readers of the original and new editions of my "Saturn and its System," please notice this point: Cassini and not Ball discovered the division in Saturn's ring.] WILLIAM NOBLE.

* A note which should have preceded the title of the extract referred to, was accidentally omitted. It mentioned that the extract had been sent to us by Mr. J. Ward, and seemed entirely to dispose of the claim made on Ball's behalf. Then the title (which read rather strangely) should have followed in small capitals, being really a sub-title only. We are glad to notice that a writer in the *Athenæum* has followed Captain Noble's lead, and seems on his way to the same solution and conclusion.

OXYGEN AND DISEASE GERMS.

MR. F. J. FARADAY calls attention in the *Times* to certain remarkable facts communicated by M. Pasteur to the recent Hygienic Congress at Geneva. Starting with the suggestion by Dr. William Roberts, F.R.S., that disease germs might be "sports" from harmless saprophytes which had acquired a parasitic habit, it has been argued that such "sports" might be developed by cultivation in the presence of noxious gases, or in confined places in which the proportion of free oxygen present in good air did not exist. The hypothesis has been specially applied to the evolution of the tubercle bacillus, but it is obvious that it is equally applicable to the evolution of the germs of other diseases, such as typhoid fever. The process described by M. Pasteur at Geneva, as having enabled him to convert the virus of the form of typhoid fever which caused great mortality among horses last year in Paris into its own vaccine, has a noteworthy bearing upon this hypothesis. M. Pasteur first tried to "attenuate" the virus by cultivating the specific microbe, which he had already discovered as associated with the disease, in contact with air. But experiments showed that the culture retained its fatal attributes for a certain period, when it suddenly became absolutely sterile, or, in other words, the microbe died. M. Pasteur then adopted a method which can only be adequately described as a process of nursing the microbe, so as gradually to adapt it to a new mode of life, or, in other words, to modify it without destroying its fertility. Taking a virulent culture from the blood of a rabbit which, through inoculation, had died of the disease, he sowed fresh portions of this culture in veal broth on successive days, and kept the series in contact with air. He had thus a graduated series of cultures from virulent stock in process, each of these cultures having been subjected to the modifying influence of oxygen for a different period. M. Pasteur was thus able to seize the moment when the culture which had been exposed the longest to aeration became sterile, and to select a culture on the eve of sterility, which he transferred to a fresh infusion already found to be specially suitable to the microbes, and which consisted of two parts of veal broth with one part of pure rabbit's blood. Having, in fact, reduced the microbe to the verge of sterility, or death, he subjected it at this critical moment to an invigorating regimen, and thus protracted its vitality and made it the stock of a new series of cultures. By repeating this process again and again in all its details, M. Pasteur ultimately evolved a race capable of serving as the vaccine of the original virus, oxygen having been the modifying influence throughout.

There is a striking analogy between the treatment thus described and that by means of which, about six years ago, Fräulein Marie von Chauvin evolved *amblystoma*, a land salamander, from the water-breathing Mexican axolotl. She selected healthy animals, and first kept them in shallow water, so that they were not quite covered by the water. When their health declined she restored them to deep water. Gradually she accustomed them to shallow water,

XUM

and eventually kept them on land in damp moss. She was obliged to force them to eat by compelling earth-worms to wriggle down their throats; and feeding them well at the critical stage of metamorphosis seems to have been the main condition of success. When the change from gills to lungs was perfected, they fed themselves with avidity. But Nature herself, notwithstanding the difficulties experienced by Fräulein von Chauvin in transforming her axolotls (some of which died under the treatment), apparently succeeds sometimes in evolving *amblystoma* from the Mexican newt; therefore, assuming the variability of specific microbes under the influence of oxygen, there is nothing unusual in the idea of the parasitic germs of epidemics being spontaneously evolved from harmless saprophytes under peculiar conditions of culture, such as the presence of various gases instead of free oxygen. In that case, ill-ventilated sewers, stagnant pools, and other places where aeration is not efficiently carried on, may continually evolve new crops of specific disease germs. Moreover, no embryologist will object to the attribution of the characteristics of species to the infinitely little, and the resistance to re-transformation under artificial conditions displayed by M. Pasteur's typhoid microbe is only what we might expect, on the assumption that it is a confirmed new species. Fräulein von Chauvin's axolotls had to be forced to eat under the new conditions which she provided for them, and they would certainly have died if they had been left to themselves.

The behaviour of M. Pasteur's typhoid microbe, which retained its specific or virulent character even under the influence of oxygen, until it suddenly died, is singularly like that of the axolotls. Does it not also explain the often sudden disappearance of epidemics? The typhoid germs, having acquired a parasitic or virulent habit, say in the sewer, are conveyed to the bodies of human beings. Though subsequently exposed even to the abundant oxygen of a healthy locality, they resist its influence for a certain period, spreading death meanwhile, and then, under the influence of sanitary conditions, they suddenly become sterile and the epidemic disappears.

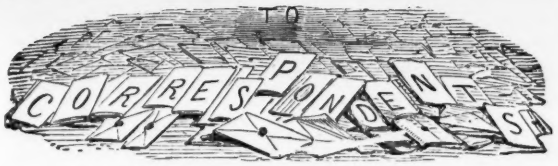
Reviews.

"TALKS ABOUT SCIENCE."*

WE have been anxious to speak very favourably of this book, for reasons which will suggest themselves to our readers; but we cannot speak of it altogether so favourably as we could wish. The duty we owe to our readers conflicts with our wishes. It is but fair to mention, however, that Mr. Welsh, in the preface, says the volume has been prepared "rather as a slight memento of one whose method of teaching endeared him to a wide circle of students, than as containing any original contributions to the general knowledge of the subjects of which it treats." Many, doubtless, will like to possess this little book as a memorial of Mr. Dunman's life and labours. Here, however, we are concerned only to inquire how far the papers before us present the true facts of science, and what are its qualities as a literary production. Unfortunately it falls short in many important respects. We could pass over the facile way in which space is wasted, though we have little liking for the style of condescending badinage which has been introduced by some South Kensington writers and lecturers, a style which the author of this book seems to have borrowed rather than independently adopted. When Mr. Lockyer tells us, for instance, that rays, after passing into the spectroscope, "tie themselves into a true lover's knot, before they come out again" we do not feel that the image, however familiar, is either explanatory or poetical. Nor are the phenomena of solar atmospheric absorption explained by saying that certain rays "are gobbled up on their way to the earth, and come to us with a balance on the wrong side of the account." But apart from faults of style which Mr. Dunman has copied from his exemplars, there are many serious errors as to matters of fact in the papers before us. There is no reason, for instance, if readers like that style, that a writer should not explain in a condescending manner why we wear dark clothes in winter; but the explanation should be correct. In a single paragraph, the book before us tells us that dark clothes conduct heat better than light ones; that they keep in the heat better than light ones; that light clothes radiate the heat instead of absorbing it: all which statements are quite incorrect. Mr. Dunman's explanation of the way of finding the latitude at sea is open to exception. "Supposing," he says, "a sailor wants to find out his latitude—in other words, his distance from the equator—this is what he does. Certain bright stars are well known to him; he knows exactly how far off they are from the North or South pole, as the case may be; he turns his telescope to a star which he knows to be 10° from the north or south, but he finds out that that star is 30° away from the point over his head—that is to say, 30° away from him; thirty and ten are forty, he knows that he is 40° from the North Pole. Now, the distance from the Equator to the North Pole is 90°, and forty from ninety, any boy in the first standard will tell you, leaves fifty; and therefore the sailor knows that he is in 50° north latitude by such an observation as the one I have supposed. So, you see, the finding your latitude is simply noticing your distance from certain stars, the position of which is well known." The explanation is very plainly worded, but unfortunately it is entirely erroneous. Such parts of it as are, we suppose, intended correctly, are unmeaning. It is just such explanations as these which send an audience away from a lecture with the feeling, "Dear me, how easy it all is!" A feeling which changes presently to the thought that nothing has been really explained. After all, it is easy to explain nothing (our public men do that for us every day). It is also easy to understand nothing. Naturally, in treating the much more difficult subject of the longitude more mistakes are made. Mr. Lockyer's mistake, which makes noon observations at sea do duty for determining time, which of course they are quite unable to do, is repeated. The lunar method, which Mr. Dunman calls the lunar theory of finding the longitude, is then tackled, which would have been a daring feat for Sir John Herschel. "I don't know of any one having attempted to make that most abstruse subject clear to a popular audience" Mr. Dunman admits. This is how the difficult task is achieved. "There is published in London a wonderful almanac, called the 'Nautical Almanac,' which is published every year five years in advance, and in that almanac there is laid down the exact Greenwich time for every possible position of the moon among the stars. Consequently, all that the sailor has to do is to find the exact position of the moon among the stars, and to turn to his 'Nautical Almanac,' and having found that position against it he will see marked the Greenwich time." It would be well, indeed, for sailors if the matter were as simple as it is here described.

There is much pleasant reading in this work; but we are afraid we cannot honestly say it is a trustworthy guide on any subject of which it treats.

**Talks about Science.* By the late Thos. Dunman, with a biographical notice by Charles Welsh. (London: Griffith & Farran.)



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

THE SCHOOL OF TELEGRAPHY AND ELECTRICAL ENGINEERING.

[589]—The more critical portions of the article on Electrical Engineering which appeared in your issue of September 22—an article which, rendering unsolicited justice to the endeavours we have made for many years past, goes far to repay us for the labour and sacrifices which have accompanied them—has received very careful consideration on our part. This has confirmed us in our determination, to which we had already nearly arrived, to increase from six to nine months, the period in which we undertake to qualify for useful electrical work, any youth possessed of a fair educational training, and a taste for some of the applications of science. But we feel called upon to give some explanation of the method by means of which we have obtained a most encouraging measure of success—in some cases even beyond our expectations—within the smaller minimum period of tuition, and of the reasons which induce us to think that the longer period above-mentioned—which might still be regarded as inadequate—will be ample for our purposes under our system of tuition. We have already intimated that we do not accept as students those who have not in themselves some foundation upon which we can build a superstructure of useful and extensible theoretical and practical knowledge. And, as we have also intimated, we are sometimes surprised at the amount of natural talent we find, only waiting for development under a proper system. A capacity for somewhat severe work is a primary qualification we do not lose sight of. Then it is part of our system to make practical and experimental work a recreation in respect to theoretical studies, and *vice versâ*. We may claim also that it has been our good fortune to secure the best available talent and knowledge for technical tuition; in some cases from quarters in which, by reason of pressing demands upon time, co-operation in this direction would ordinarily be declined. For instance, some of the editors and members of the editorial staff of more than one of our foremost technical journals take charge of certain branches of tuition. It should be mentioned also that endeavours are always made to discover the particular or most prominent aptitude of each student, so that his energies may be directed into the right channel. To this course we, in great measure, ascribe the fact that so many of our men, shortly after leaving the school, find themselves, *facile principes*, virtually, if not ostensibly, at the head of some important branch of some large commercial undertaking.

In regard to the theoretical training: this may be considered under the two broad headings of electro-statics and electro-dynamics, each being interlinked with certain kindred studies. Ordinarily, the former of these two branches would be neglected, and attention would be given almost exclusively to the latter of them, since they have been considered as two very distinct sciences, of which the latter is practically the more important. But it may safely be stated that no electrician can have any real mastery over his work who is deficient in electro-statics. Now the main characteristic of the theoretical training at the school is that the student is not called upon to wade through two totally distinct sciences. The perfect analogy between the two branches of electrical science, the almost absolute identity of the theoretical and practical formulæ involved in them, is not only pointed out, but acted upon to the extent of making the two branches mutually elucidate each other. It is not too much to say that if the analogy in question were ignored—as too frequently it is—nine months' tuition would be altogether insufficient for the theoretical training alone; whilst its recognition throws such a light upon the science that within six months the student may feel that he already has mastered its essential principles, and holds the clue to its more recondite details.

In regard to mechanical work, we may mention that the students are encouraged to take to pieces and reconstruct the instruments and apparatus, dynamo-machines, lamps, &c., used for their daily practical instruction. They receive information also as to the construction and working of steam and gas-engines, economy of fuel, &c.

We have hitherto taken no notice whatever of the statements, more or less unjust, if not injurious, to ourselves, which have recently been put forward in advertisements issued by the new establishments which have sprung up in various directions; but we may without offence point out that the real requirements and difficulties of tuition in the direction aimed at are as yet unknown, and have not only to be discovered, but also overcome by the promoters of these undertakings. T. J. JONES.

12, Princes-street, Hanover-square, W.

EFFECTS OF ALCOHOL.

[590]—After feeling nearly exhausted by a long and fatiguing day's work, which terminates at 10.30 p.m., with, perhaps, a stiff North-easter and a shower, as a finish-up on the way home, J. S., in letter 583, p. 314, advises me, as an improvement on my habit of taking a small quantity of alcohol mixed with light food, "to have a cold bath, followed by dumb-bell exercise." He also wishes to have my opinion of his proposition.

Well, I think his remedy incomplete. A slight touch on the head with a poleaxe would give the requisite finish. MEPHISTO.

FIGURE-TRAINING BY CORSET.

[591]—From time to time the advocates of stays or no stays give forth their extreme notions, most of them crude in nature and physiologically wrong. It is difficult to tell in what light some of them view the matter, for the conclusions to which they are led indicate that they have been jumped at without thinking.

The letter No. 560, on page 267, is a step in the right direction, showing an inclination on the part of the writer to adopt moderate views and express a reasonable opinion. I do not believe for one moment with F. U. H. that fully 90 per cent. of women are deformed by stays; it would be extremely difficult to arrive at a safe statistical conclusion at all. If such were the case, I should not hesitate to say that 90 per cent. of women know nothing of lacing, for if lacing the figure is practised in a judicious manner, instead of deformity would come elegance and health. If such a statement be taken as true, then 90 per cent. do not know how to apply the corset.

A well-applied corset leaves the upper part of the chest perfectly free, and developes the capacity of the lungs in that situation—the most important situation, by-the-by, especially in the female sex. Tubercular consumption usually attacks the apices of the lungs, a part far removed from the pressure of a corset, however tight—in fact, the tighter the corset in the lower part of the chest, the greater amount of work and expansion in the upper part, but this would not lead to consumption. A similar state exists during pregnancy, when the uterus encroaches upon the lung space.

There appears to be only one way in which tight-lacing directly can bring about consumption, and that is by so compressing the lung in its lower part that no fresh air can enter it, a sort of collapse and carnification ensuing, a diminished use leading to degeneration of lung tissue. Such a state of affairs would only take place when tight lacing has been suddenly performed and persisted in at an age when the figure has become somewhat set.

A woman is better in health, and certainly far more elegant in figure, when wearing a proper-fitting corset; nor is she so liable to suffer from such diseases as consumption, dyspepsia, or spinal curvature. I quite deprecate, however, beginning tight-lacing suddenly or violently with the simple object of reducing the figure quickly to genteel proportions, or for fashion's sake.

What I consider to be perfection in the application of the corset to the female figure or to the male is to begin early in life, say at the age of seven or ten years, and then only with very yielding materials, permitting the corset simply to touch the contour of the body, though a little firmer at the waist. As the girl grows up the chest expands, the bust of the corset may be very properly made larger, the waist at the same time being kept within bounds, I do not doubt some would advocate it being kept at its original measurement. If such a system be carefully carried out, there never would

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be any undue pressure anywhere, and the girl who reaches womanhood will possess the perfection of a figure with its round and taper waist, broad shoulders and well-developed chest. She will be devoid of that lounging habit and stooping gait which is the natural consequence of no stays, or of stays imperfectly or injudiciously applied. It always was and will be necessary to restrain, limit and correct the growing figure. Without aid nature seldom forms a good waist. Gradual and early correction, instead of violent and sudden reduction of deformity, is the way to achieve success—no evil effects can possibly ensue. Parents should see to this matter, and take as much interest in the physical growth and proportion of figure of their children as they do in their mental development.

In the wearing of the corset, the degree of comfort with which it is borne should be the test of utility. Early care and judicious management will in every case succeed in attaining elegance and in preserving health. ALFRED CHADWICK, M.D.

LETTERS IN TYPE.—Physiological Experiment, by Z.; Talking Canary, &c., by Charles L. Cane; Dr. Hunter's Experiments, by Mathilde Van Eys; Coincidences, by A. R. W.; Lapidaries and Deception, by H. M. W.; Wollaston & Fairy Rings, by A. W. Soward; The Fifteen Puzzle, by A. B.; Flint Jack, by E. T. C. W.; Long Tricycle Ride, by J. F. P.; Spiritualism, by E. P. W.

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2 *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

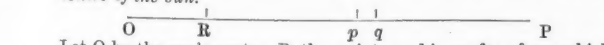
NEWTON CROSLAND. What Professor Smyth says is in perfect agreement with what I said. Observe, he says, "moderates the excesses," meaning that the water vapour causes the difference between the temperature of the day and night to be less; it does this by very slightly diminishing the heat received from the sun (scarcely to any perceptible degree in fact), while it very largely diminishes the radiation from the earth at night—in fact most of the time.—C. C. C. C. Your method of dealing with sums in double rule of three is good, but we have not space for it. I know of a way of putting the matter which I have found very easily understood. It will occupy less space than yours, and I may presently give a short note about it.—STANLEY BALDWIN. Some of the accounts of fairy rings given by correspondents cannot be explained in that way—that is, that they grow over the roots or stumps of trees.—E. J. HOLLOWAY. Glad you are pleased.—E. C. D. Do not know which would be called the best books of geometrical riders? You will find the names of several books on squaring the circle and trisecting the triangle in De Morgan's "Budget of Paradoxes."—WM. WOOD, JUNR. I should have said a few weeks ago, "Would that there were more readers like you;" but since I asked for opinions about the weather charts, I have received so many kind and considerate letters, that I now quite recognise what a very small proportion of readers the grumblers represented.—ABSTAINER. I so fully recognise the misery produced by excessive drinking, and I know so well how many there are who cannot abstain from excess, and therefore should abstain altogether from alcohol, that I cannot but sympathise with your views. But I fail to see why those who have not the slightest temptation to exceed their usual moderate allowance should be expected to give in their adherence to your theory that everyone ought to be a Blue Ribbonist. Let the weaker seek safety in such resources, and be content to let us go on in our own way. In fact, let the Blue Ribbon be regarded as the badge of those who cannot trust themselves. It is usually understood, I find, to be worn only by reformed tipplers,—which is rather hard on the Blue-Ribbonists.—NO ALCOHOL. That was, ten years ago, my own experience, but I have latterly found reason to agree with my "learned friend."—LEANDER. The circular halo round the sun is caused by minute particles of ice in the upper air; it is, therefore, not properly termed a rainbow.—J. M. G. Do not know the price or publishers of the works you name.—G. GLASGOW. (1.) The star α Cygni, or Arided, is of the second magnitude. (2.) The map of Ursa Minor is very inaccurate; a bright star between the Pole-star and the Guardians has no existence as such in the heavens. Then three stars really belonging to Draco are shown as belonging to the Little Bear. (3.) I think the Nebula in Andromeda may as well be shown, though there is no absolute necessity for so doing. (4.) The stars you name—τ, μ 15, and π—are all of the fifth magnitude.—PLONI ALMONI informs "Constant Reader" that there is a Microscopical Society in Liverpool, and that Mr. Thompson, of 6, Lord-street, might be able to tell him the Secretary's name. Best book probably Nicholson's, but Cornish, of Piccadilly, and Owens College, Manchester, would send him a list to choose from. He further recommends Stanley Jevons' elementary book on Logic. I intended my reply to "T. A." to mean only that in several explosions there has been the out-rush to which he had referred.—THOMAS KIMBER. Time-differences between various places seem so easily dealt with when the longitude is known, that I cannot see the advantage of any of the plans you mention. —C. FRANCIS. (1.) I do not know of any scent that will "make a person light," nor of any that will "set him right when he has been made light;" I cannot say that I quite know what you mean, either. (2.) Doubtless some correspondent will tell you a way of making silk air-tight.—H. F. The *Intellectual Observer* is not now in existence,—worse luck. It was one of the very best science magazines ever published.—G. CAIRD desires information about Royal Exhibitions at the Normal School of Science. He asks if Todhunter's Trigonometry for Beginners is sufficient for Honours third stage or for ordinary third stage.—WILLIAM DAVIES. The magnets would keep the pendulum in motion, at least for a time; friction would soon bring it to rest.—HARVARD GRAHAME points out that Mr. Ackroyd's results, instead of being in opposition to those in the *Chemical News*, are in perfect agreement with them, and, in fact, might be deduced from them. In one case there is a scale of colour reflected from substances at different temperatures, while in the other we have a scale given out by bodies raised to temperatures at which they become luminous.—A. J. HAYNES desires information about American universities. In reply to his query about the absence of mathematics, we note that no less than eight sections of the articles on the Differential Calculus are now in the printer's hands; four are in type.—E. C. H. Your questions are worthy of a fuller notice than we could give you in these short answers. Will try to deal with them soon.—AND. AITKEN. Many thanks for your suggestions, with which I quite agree. As to the Differential Calculus, I think Todhunter's as good a book of its kind as you can readily use. —E. T. C. W. (1.) Vol. II. will close, as you say, with No. 61. (2.) Pages v. (No. 33), vi. (No. 43) not to be bound up. (3.) No particular results followed from the Hippocampus controversy; both the disputants considered that they had the best of it. (4.) I have not been specially informed on the subject, but—at a venture—I should say that when the moon was commanded to stand still over Ajalon by Joshua, this did *not* "make any difference in its motion," and the moon *could* and did "turn exactly the same face towards the earth before and after." I was not there at the time, however, and should not care to speak positively as to what did or did not happen in that encounter. Can you, in turn, tell me whether Scamander flowed as before after Vulcan "breathed" that "fiery blast around," which caused the river to "rear his languid head," and appeal, "short panting," for a rest? But possibly you were not present on that occasion.—S. J. There is ample room for you in the waste-paper basket; send some more.—B. M. You could not find any cyclopædia without omissions or imperfections. It would be unfair to note those of one in particular.—TRIFLER. If you insist that $0^{-2}=0$ (or, if you like it better, that $0^{-1}=0$), there is an end of the matter. You begin with a mistake and naturally obtain an erroneous result, which you call a sophism. You can explain it your own way,—with great ease, I should imagine.—A P. S. Thanks: this world enough for the present; the "occult" does not specially interest me.—HALLYARDS. Your letter would raise discussion which would be out of place in KNOWLEDGE.—R. LEIGH. Thanks, but correspondents prefer we should make no attempt at weather-charting in any way.—J. STACK. I agree with you that medical aid which simply keeps life in a used-up and depraved body is not an unmixed blessing. But your views might be misunderstood, and so offend.—J. J. RUBIE. The elastic recoil would suffice if you breathed out into a perfectly elastic bag; but how is the energy in the moving air, as it leaves the lungs, to bring air back again?—J. B. Possibly some correspondent can tell you the best way of destroying crickets. The following acted well "in our house at home," some three years back:—A careless servant (first provide your careless servant) left two or three used tins which had once held condensed milk, and were still wet and sticky, inside the kitchen fender. Next morning they were full of cockroaches and crickets, which were forthwith consigned to a watery (boiling watery) grave. Next night no insects appeared on the scene. Soon after some young ones began to be seen, which were caught in like manner. For months afterwards the kitchen was clear of these nuisances. If you should try the method and it succeeds,

please let me know.—A. A. Murdoch. No room for Draughts or Billiards, though undoubtedly, like Whist and Chess, scientific games.—H. M. Thanks, but no space for your story. It shows that trout clearly recognise the difference between "the free and the constrained motion of a rigid body;" yet, I dare say not one of them has studied Routh's "Rigid Dynamics."—A. McD. Mr. W. M. Williams's theory is not open to the objections you make. According to it, as he explains it in his "Fuel of the Sun," our oceans could not be diminished by evaporation, for he supposes interplanetary space to be "saturated"—that is, whatever amount of aqueous vapour would saturate the interplanetary atmosphere at any point, at the temperature and pressure there existing, is actually present. This answers the first three questions. As to the fourth, it is impossible to say what the weight of the vapour of water is, unless you say where, and under what conditions, it exists at the moment.

Letters Received.—J. Munroe, F. Gardener, J. Searson, F. W. Richardson, Hallyards, J. M. L., Young Chemist, F. C., Wood, Opifer, B. Lingwood, Taranaki, W. H., Bansall, Newton Crosland, S. Spicers, Dentist, H. B. Richardson, G. Griffith, H. G. White, W. P., E. Brown, H. A., T. A., Surgeon, J. B., F. W. Lambley, F. R. M., J. Greenfield, A. W. Soward, I. Probert, Vega, A. G. Haynes, Matriculating Student, J. Fraser, Malcolm Douglas, Subscriber, E. Irving, J. H. Ward, Odontalgia, Excelsior, G. Massie, C. Carus-Wilson, E. T. C. W., A. Leluem, J. T. B., T. N. A., M. E. L., C. Witham, J. E. S., C. S., L. Dobbin, Naus Solanum, E. D. G., J. Spiller, Grateful, C. E. S., W. B. Wicken, H. H. Newton, C. H. Romanes, Ignoramus, F. Keith, D. Illingworth, A Highlander, J. P. K., Upsala, G. R. W., M. B. A.

Our Mathematical Column.

To determine the time in which a body leaving the sun's surface vertically, with a velocity of 380 *miles per second—being that with which a body travelling to the sun's surface from rest at an indefinitely great distance would reach that surface under the influence of his attractive force—it is required to determine how long that body would be in reaching a distance of thirty millions of miles from the centre of the sun.*



Let O be the sun's centre, R the point on his surface from which the body is projected; OR = 430,000 miles, OP = 30,000,000; but put OR = r, OP = a. Also let OP = x, $pq = dx$, and velocity at R = v. Then we know that the velocity of the body varies inversely as the square root of the distance from O. Hence velocity at $p = v\sqrt{\frac{r}{x}}$, and time of traversing $pq = \frac{1}{v}\sqrt{\frac{x}{r}}dx$. Hence time of traversing the distance RP

$$= \frac{1}{v\sqrt{r}}\int_r^a \sqrt{x}\,dx$$

$$= \frac{2}{3v\sqrt{r}}\left[a^{\frac{3}{2}} - r^{\frac{3}{2}}\right]$$

$$= \frac{2}{3v}\left[\sqrt{\frac{a^3}{r}} - r\right]$$

Now $\frac{3v}{2} = \frac{1140}{2} = 570$; and $\sqrt{\frac{a^3}{r}} = \sqrt{\frac{270}{43}}$. 100000000, the mile being the unit of length and the unit of time.

Whence the quantity within square brackets = 250,000,000 nearly enough. And the time required

$$= \frac{25{,}000{,}000}{57} \text{ seconds}$$

$$= \frac{25{,}000{,}000}{57 \times 3600 \times 24} \text{ days}$$

$$= \frac{25{,}000}{4925} \text{ days (approximately)},$$

$$= \frac{1000}{196} = 5\tfrac{5}{49} \text{ days}.$$

This is also very nearly the time in which a comet, moving in exceedingly eccentric orbit, with perihelion close to sun, would take in reaching the same distance from his centre.

Caution.—Beware of the Party offering imitations of the "Big Waverley" and Big "J" Pen. Sold by all respectable Stationers throughout the world.
"They come as a boon and a blessing to men,
The Pickwick, the Owl, and the Waverley Pen."
Also the Hindoo Pens, Diagonal Points, Nos. 1, 2, and 3. Sample Box with all the kinds, 1s. 1d. by post. Patentees of pens and penholders, Macniven & Cameron, Pen-makers to her Majesty's Government. Offices, 23, Blair-street, Edinburgh. (Established 1770

Our Whist Column.

By "Five of Clubs."

The evenings are closing in again, and Whist begins to resume its place in the day's recreations. We propose, therefore, to continue our discussion of the principles of Whist play, with occasional illustrative games, problems, Whist gossip, and so forth.

But as some of our readers may have forgotten what we have already written, we propose to give a very brief summary of the chief rules,—those rules which every Whist-player ought to have constantly in his memory, the breach of them being, in fact, Whist atrocities. For details the reader can consult our former papers.

The Lead (from strength in plain suits),

See preceding numbers, especially No. 14.

Lead *Ace*—

(1.) From Ace and four others at least, following with small one; or (2) from Ace, Queen, Knave, with or without others, following with Queen if there were not more than four in the suit originally, otherwise with Knave.

Lead *King*—

(1) From Ace, King, and others; following with King. (2) From King, Queen, and others; following with small one if King makes.

Lead *Queen*—

From Queen, Knave, Ten; following with Knave, if Queen makes, unless you were more than four in suit originally, when follow with lowest of head sequence.

Lead *Knave*—

(1) From King, Queen, Knave, two others or more. (2) From Knave, Ten, Nine, with or without small ones. Sequent play will depend on the fall of cards in the first round. The trick will not probably fall to leader in either case, as either adversary or partner, holding Ace, would generally play it.

Lead *Ten*—

(1) From King, Queen, Knave, Ten, and (2) from King, Knave, Ten, with or without others.

Lead *Nine*—

From King, Knave, Ten, Nine.

In other cases lead *lowest* if you have only four cards; lowest but one (the *penultimate*) if you have five or more; some play lowest but two (the *ante-penultimate*) when holding six or more.

The Lead in Trumps (from strength).

Note the trump card, and only lead up to an honour turned on your right when very strong. Do not hesitate to do so, however, when you have strength in trumps, and either you or your partner has a good suit. Play a waiting game in trumps, your object being rather to get the command than to win the earlier rounds. From King, Queen, and small ones, it is generally better to lead the lowest.

Leading from a Weak Suit.

From Ace, King, or Queen, with two small ones, it is best to lead the lowest, unless you have reason to believe your partner has strength in the suit. (Some, however, from Queen two small ones, lead Queen.) In other cases, when obliged to lead from a three-card suit, lead the highest. From two cards, if driven to such a lead, invariably lead the highest.

N.B.—Note the inferences from these rules. Your own hand will often serve to tell you precisely what the lead means. Thus, suppose Ace is led and you hold King, Knave,—you then know the lead is from Ace four others. Again, Knave is led by your partner first round, and you hold King, Ten; you know that the lead is not from strength (see leads from strength above); hence, that your partner holds four trumps, and three three-card suits, all weak, the best being headed by the Knave played. So in multitudes of other cases.

Play Second Hand.

With King, Queen, one other, or Queen, Knave, one other, or Knave, Ten, one other, or Ten, Nine, one other, play lowest of head sequence; but with same head sequence and two others or more, play lowest. With King, one other, or Queen, one other, in plain suits play the lowest, unless you specially want the lead.

Of course, there are other rules for play second in hand, see Part 21 and several preceding parts; but these are the most elementary rules—though often neglected.

In our next we shall summarise the rules for play third and fourth hand, and repeat some of those general rules which form the elementary language of the game. We shall then resume our more complete analysis of Whist principles.

XUM

Our Chess Column.

By Mephisto.

SOLUTIONS.

Problem No. 54, by John Simpson (p. 286) :—

1. Q to QB4 — 1. B to Q3
2. R to R8 (ch) — 2. K to Kt8
3. Q to B sq mate

1. (*a*) — 1. K to Kt6
2. Q to R4 (ch) — 2. K takes Q
3. Kt to B5 mate

1. (*b*) — 1. K to Kt8
2. Kt (B2) to Kt4 — 2. Anything
3. Q to B sq mate.

End Position, No. 55, by Leonard P. Rees (p. 302).

Sir,—I have been trying to solve Mr. L. P. Rees's "End Position from Actual Play" (Position No. 55), and the following is the result of my labours :—

1. B to Q5 (ch) K to K sq, or
2. Q takes RP R takes Q (*a*)
3. R to Kt8 (ch) K to K2
4. Kt to B5 mate, or
2. (*a*) if Kt tks P (*b*)
3. B tks Kt (ch) K to B sq
4. Q tks R (ch) K to K2
5. Q to K8 (ch) K to Q3
6. Q to Q7 or Kt to B5 mate
2. (*b*) if Q or B takes Kt or B to R3
3. Q to B7 (ch) K moves
4. R to Kt8 (ch) R takes R
5. Q tks R (ch) K to K2
6. Q to B7 (ch) K to Q1 or 3
7. Q mates

1. K to K2
2. Kt to B5 (ch) K to K sq (*a*)
3. Q takes RP Kt takes P.
4. B tks Kt (ch) K to B sq
5. Q mates

2. (*a*) K to Q sq
3. Q takes RP Kt takes P
4. R to Kt8 (ch) R takes R
5. Q tks R (ch) K to Q2
6. B to K6 mate

These appear to me to be the principal variations, as the others are mostly but transpositions of some of the above moves. It seems too good for an "End Position from Actual Play." I mean there is too much variation, or at any rate, more than one would expect.—G. Woodcock.

Another version :—

1. R to Kt8

(If B moves K takes R or B takes Q, White mates on the move by B to Q5.)

1. R takes R (best)
2. Q tks P (ch) and wins

(Any other move for Black leads to a similar result.)

A pretty end position, which one would scarcely have expected in actual play.—H. Seward.

[After 1. R to Kt8, R takes R. 2. Q takes P (ch) if Black plays 2. R to Kt2 then 3. B to Q5 (ch), K to B sq. 4. Q to R8 (ch), K to K2. 5. Kt to B5 mate. Or, if in reply to 2. Q takes P (ch), Black plays K to B sq, then 3. B to Q5 wins in a similar manner. —Ed.]

Herbert Jacobs sends the following solution :—

1. Q takes P (ch) — 1. R takes Q.
2. B to Q5 (ch) — 2. K to B sq
3. R to Kt8 (ch) — 3. K to K2
4. Kt to B5 mate

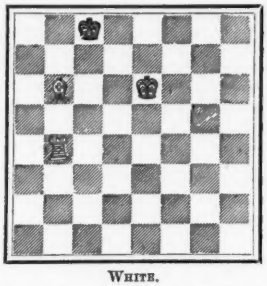
[If in reply to 1. Q takes P Black does not take the Queen, but plays K to K3, then White wins by 2. Q takes R, for if Black replies with 2. Q takes Kt, then 3. Q to K8 (ch), K to Q3. 4. Q to B8 (ch), K to K3. 5. P to Q5 mate. Again, if Black plays 2. P takes P, then 3. Q to K8 (ch), K to Q3. 4. Q to B8 (ch), K to K3. 5. B to Q5 (ch), K to K4. 6. Q to K7 mate. Or if 2. Kt takes BP then White plays 3. Q to K8 (ch), Kt to K2. 4. B to B5 (ch), K to Q3. 5. Q to Q7 mate.—Ed.]

The study of this position ought to convince the most inveterate doctrinaire that the problems presented by actual play, unlike those artificially made, are capable of various solutions, and that there may be different ways of accompliishing the desired end, and finally that different views from that taken by ourselves ought not to be condemned rashly.

Problem No. 56.—We regret to say this problem is incorrect, a White Pawn placed either on KKt4 or KKt6 would render it sound. It can be solved by 1. B to Kt6, also by 1. B to B3.

Sir,—In your issue of last week, you published a problem (No. 57) by Leonard P. Rees. On glancing over it I immediately recognised the solution, and remembered having seen it several years ago. On reference I find the enclosed problem (the solution of which is identical with Mr. Rees's) was composed by Mr. Chas. Spray, of Nottingham, and was published in the *Nottingham Daily Express*, in 1878. As I, of course, concluded that Mr. Rees has never seen the enclosed, I simply call your attention to this curious and extraordinary coincidence of ideas. The problem is neat and simple.—Yours very truly, A. Marriott.

Black.



White.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Leonard P. Rees.—See solution.

E. P. W.—The variation is weak for the first player, but in the position arrived at after 9. Q to B3 White will obtain a good game by 10. P to Q4, followed if QKt to B3 or KKt to K2 by 11. B to B4 or P to K5 respectively.

John Simpson.—Problem received with thanks. Solutions correct.

Squire.—You are right. The game was probably played at the odds of a Rook. You are too good for that. We gave the ending as it actually occurred.

Herbert Jacobs.—Thanks for problem. Hope soon to deal with the subject.

Lovesmith.—Cook's Synopsis of the openings.

H. A. L. S.—Thanks for good opinion.

G. W.—Game received.

Problems No. 56 and 57 solved by H. A. L. S., H. V. T., W. C. Thomas, H. Seward, Herbert Jacobs. Solutions of No. 54 received from Herbert Jacobs, H. V. T., Belmont, G. H. Bonner, H. A. N. No. 55, Berrow, G. H. Bonner. No. 56 and 57, T. T. Dorrington, H. A. N., R. J. P., Evelyn, H. S. Squire, John O'Keeffe, Samuel Jordan, Kit, G. H. Bonner, Berrow, Belmont, John Watson, H. A. D., Novice, A. J. H., W. J. D. No. 56, J. P., Schmucke. No. 57, T. H. Jeaps, Chas. Palmer.

Berrow.—Problems received with thanks.

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